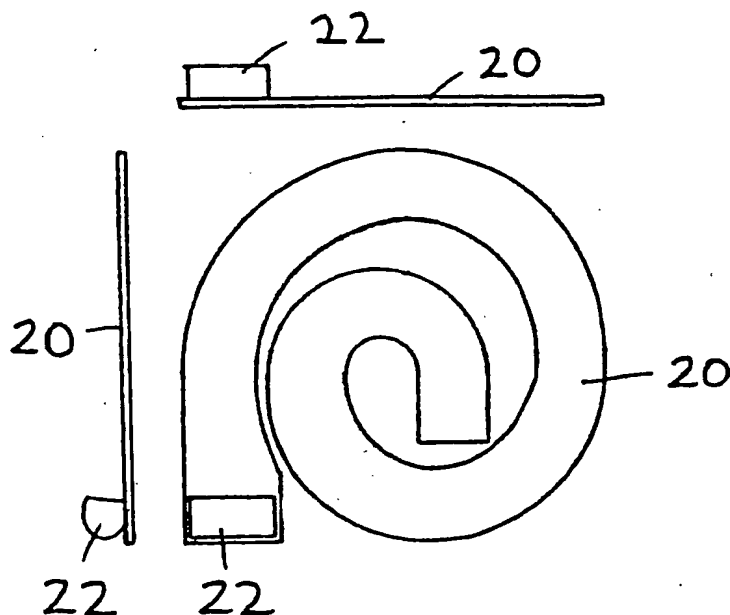




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(54) Title: **TEMPERATURE RECORDER**

(57) Abstract

A temperature recorder, e.g. for indicating the length of time that frozen food has been defrosted, comprises a reservoir 22 of coloured liquid which breaks upon freezing, and a track 20 arranged for the indicator liquid to migrate along when the liquid subsequently thaws. The position to which the liquid migrates along the track 20 gives an indication of the length of time for which the temperature of the frozen food has been above the melting point of the indicator liquid.

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TEMPERATURE RECORDER

This invention relates to a temperature recorder which may be used as a defrost indicator for frozen food or other packages.

It is a problem that if a frozen food package has been
5 thawed or partially thawed and then refrozen again, it is not possible to tell from the package that it has been temporarily thawed since originally being frozen. In some cases it does not matter that a frozen food package has thawed temporarily, providing its temperature was not above a predetermined level
10 for too long a period of time and/or the temperature which it reached was not too high.

Thus, all frozen food contains bacteria and fungi and also enzymes which were used by the food when alive. When the food is frozen, the bacteria and fungi cannot breed and the
15 enzymes cannot react with the tissues around them, so that therefore spoilage of the food is halted. When the food is defrosted, the bacteria and fungi multiply, and the enzymes react with the surrounding tissues so that spoilage of the food recommences. If the food is refrozen the bacteria and fungi
20 stop breeding but their numbers do not decrease: further, the damage caused by the enzymes ceases but is not repaired. If the food is defrosted again, spoilage of the food recommences from this new level. This cycle can continue until a critical point is reached at which the food becomes unsafe and/or
25 unpalatable. However this condition of the food may not be apparent by mere visual inspection of the refrozen food package.

I have now devised a temperature recorder which can be used to alleviate the above-described problem.

30 In accordance with this invention as seen from a first aspect, there is provided a temperature recorder which comprises a track and a capsule of coloured indicator liquid, arranged for a frangible membrane of the capsule to break due to anomalous expansion of the indicator liquid upon freezing
35 of the latter, and for the indicator liquid to migrate along said track by capillary action when subsequently thawed.

It will be appreciated that this temperature recorder is primed upon initial freezing in that at this time its indicator liquid expands and breaks the frangible membrane of the capsule: however, the frozen indicator liquid remains substantially wholly within the capsule. Then if the temperature rises sufficiently, the indicator liquid melts and migrates along the track by capillary attraction. If the product is then frozen again, the migration stops but does not retreat. If the product is subsequently thawed again, the migration of the indicator liquid along the track recommences, and so on. In effect, the temperature recorder mimics the biological action of the bacteria and other agents in the food.

Preferably the track is formed by a piece of porous material. Instead, the track may be formed by a gap between a base layer and a cover layer, the gap being sufficiently small that the liquid will migrate along the track by capillary attraction.

Preferably the track of the temperature recorder follows a generally spiral path, which may comprise a continuous curve or a series of straight lines followed by bends, extending for 360° or more. In this way the temperature recorder compensates for the randomness of orientations in which the products to which it is applied may be stored. Thus, the distance which the indicator liquid migrates along the track will tend to average out regardless of the orientation of the recorder.

In accordance with this invention as seen from a second aspect, there is provided a temperature recorder which comprises a reservoir of coloured indicator liquid and a track arranged for the indicator liquid to migrate along said track when the indicator liquid thaws, said track following a generally spiral path.

Preferably the track narrows progressively, in the direction away from the capsule of indicator liquid, so that its rate of migration remains uniform regardless of its position along the track.

The track may be expanded in width at predetermined points along its length, to delay the migration at these points. These points can thus indicate that the temperature

has exceeded a limit of thawed time and/or temperature, such that the product should not be refrozen, or alternatively where it is sufficiently thawed to cook.

The track may be arranged to reveal a message at a
5 predetermined point when the indicator liquid reaches that point: for example a non-absorbent print may be formed on the track, which prevents the indicator liquid from migrating into the region so printed.

It will be appreciated that the temperature recorder
10 can be used on products other than frozen food, e.g. drugs and medicines.

Embodiments of this invention will now be described by way of examples only and with reference to the accompanying drawings, in which:

15 FIGURE 1 is a view of a frozen food package provided with a first embodiment of temperature recorder in accordance with this invention, in the form of a defrost indicator;

FIGURE 2 consists of a plan, side and end views of the defrost indicator shown in Figure 1;

20 FIGURE 3 consists of plan, side and end views of a second embodiment of defrost indicator; and

FIGURE 4 consists of three enlarged sectional views of a part of the defrost indicator of Figure 2, shown before freezing, after freezing and after subsequent thawing (or
25 partial thawing).

Referring to Figure 1, a frozen food package 10 is shown with a defrost indicator 12 fixed to its outer surface, preferably as shown the top surface of the package. As shown more clearly in Figure 2, the defrost indicator comprises a
30 track 20 and a reservoir 22 at one end of the track 20: the track follows a curved, spiral path which extends inwardly from the reservoir 22, over about $1\frac{1}{2}$ turns. In the alternative embodiment shown in Figure 3, the track 20 follows a straight line path which turns through a right angle at intervals, again
35 spiralling inwardly from the reservoir 22 and, in this case over two full turns.

As shown in Figure 4, the defrost indicator comprises a base layer 30 and a top layer 32, both e.g. of plastics material, and of shape corresponding to the spiral track just

described. The base and top layers are joined together along their edges, but a capsule 34 of liquid 35 is enclosed between the two layers at one end of the track, to form the reservoir described above. A strip 36 of absorbent material (e.g. porous paper such as blotting paper) is also enclosed between the base and top layers 30,32 and extends along the track 20.

The liquid 35 within the reservoir capsule 34 is water to which a suitably coloured dye has been added: the liquid may include a further additive to give the liquid a predetermined melting point lower than 0°C. The condition of the reservoir capsule 34 prior to freezing is shown at (a) in Figure 4. When the capsule 34 is frozen, the liquid 35 expands and breaks a frangible membrane 37 of the capsule: the condition of the capsule at this time is shown at (b) in Figure 4. Should the temperature of the defrost indicator rise and the indicator liquid 35 thaw, then this indicator liquid will start to flow and will migrate into the absorbent strip 36 and along the track 20, as shown at (c) in Figure 4. If the temperature drops again, the liquid will freeze, and its migration along the track 20 will stop: thus, the liquid will not migrate any further, nor will it return to the reservoir.

Accordingly, the position to which the indicator liquid migrates along the track 20 gives an indication of the length of time for which the temperature of the package has temporarily been above the melting point of the indicator liquid.

The spiral nature of the track 20 compensates against the randomness of the orientation at which the package 10 may be stored, as explained above.

CLAIMS

- 1) A temperature recorder which comprises a track and a capsule of coloured indicator liquid, arranged for a frangible membrane of the capsule to break due to anomalous expansion of the indicator liquid upon freezing of the latter, and for the indicated liquid to migrate along said track by capillary action when subsequently thawed.
- 2) A temperature recorder as claimed in claim 1, in which the track comprises a piece of porous material.
- 10 3) A temperature recorder as claimed in claim 1, in which the track comprises a gap formed between a bare layer and a cover layer, the gap being sufficiently small that the liquid will migrate along the track by capillary action.
- 4) A temperature recorder according to any preceding claim, in which the track follows a generally spiral path.
- 15 5) A temperature recorder as claimed in claim 4, in which the spiral path comprises a continuous curve.
- 6) A temperature recorder as claimed in claim 4, in which the spiral path comprises a series of straight lines followed by bends, extending for 360° or more.
- 20 7) A temperature recorder comprising a reservoir of coloured indicator liquid and a track arranged for the indicator liquid to migrate along said track when the indicator liquid thaws, said track following a generally spiral path.
- 25 8) A temperature recorder as claimed in claim 7, in which the track narrows progressively, in the direction away from the capsule of indicator liquid, so the rate of migration of the liquids remains uniform regardless of its position along the track.

- 9) A temperature recorder according to claims 7 or 8, in which the track is expanded in width at predetermined points along its length, to delay the migration of the liquids at these points.
- 5 10) A temperature recorder according to any of claims 7 to 9, in which the track is arranged to reveal a message at a predetermined point when the indicator reaches that point.
- 11) A temperature recorder according to claim 10, in which the message is printed on the track in a non-absorbent print.

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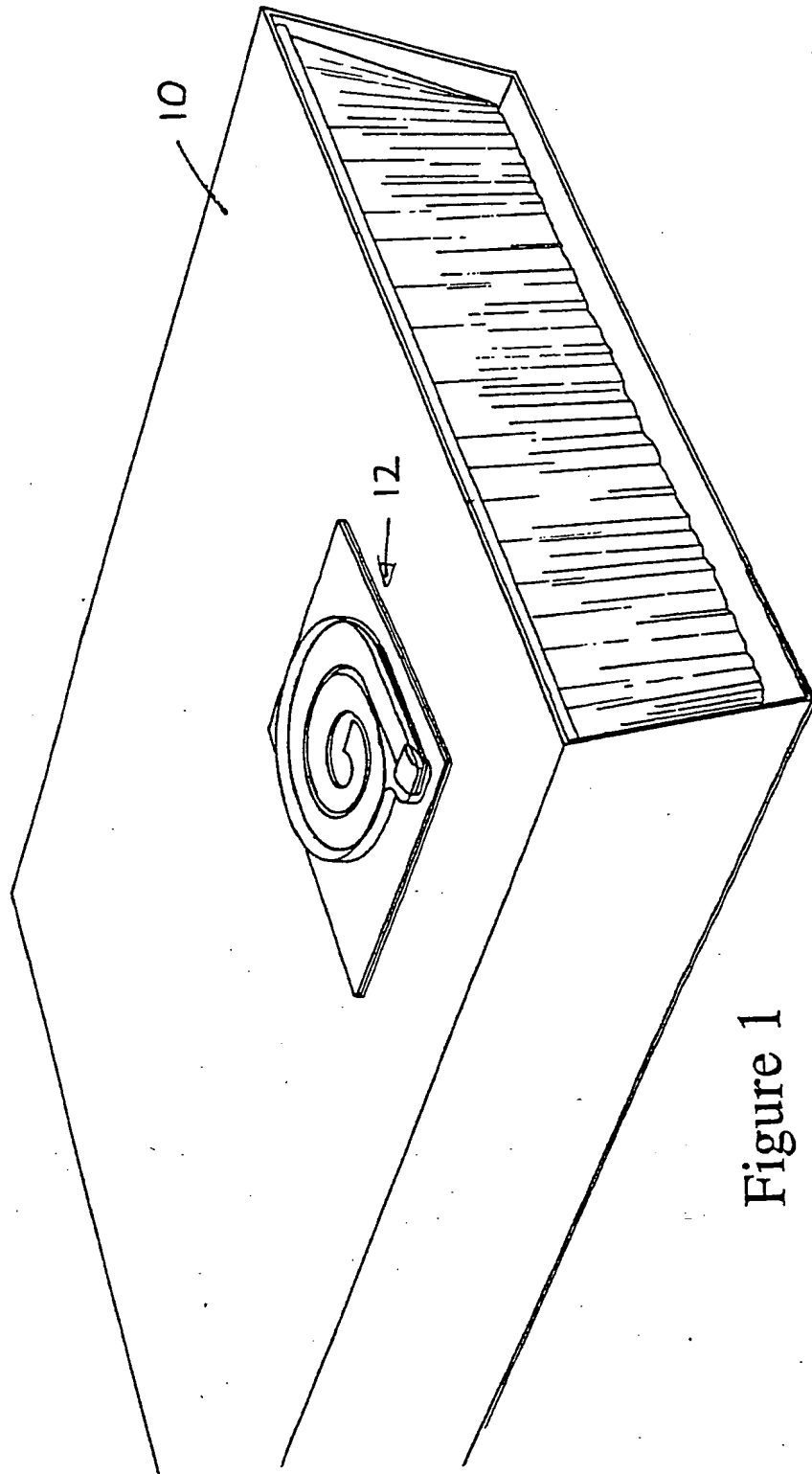


Figure 1

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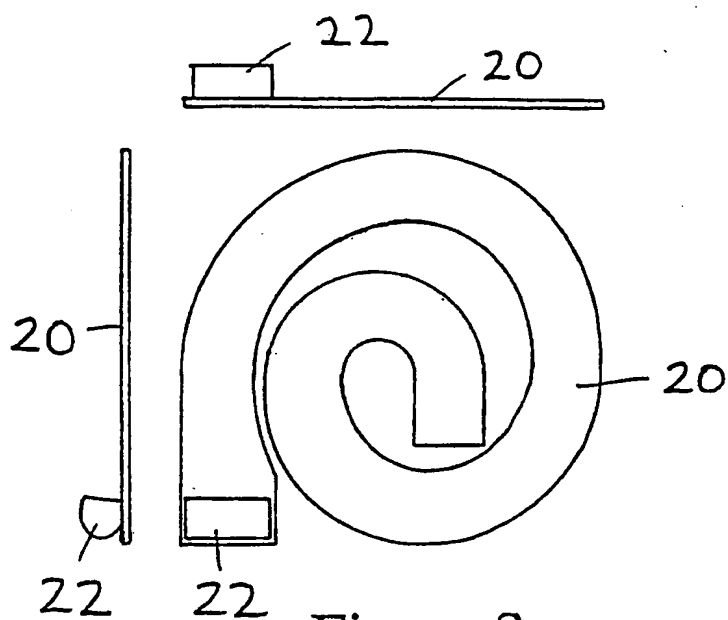


Figure 2

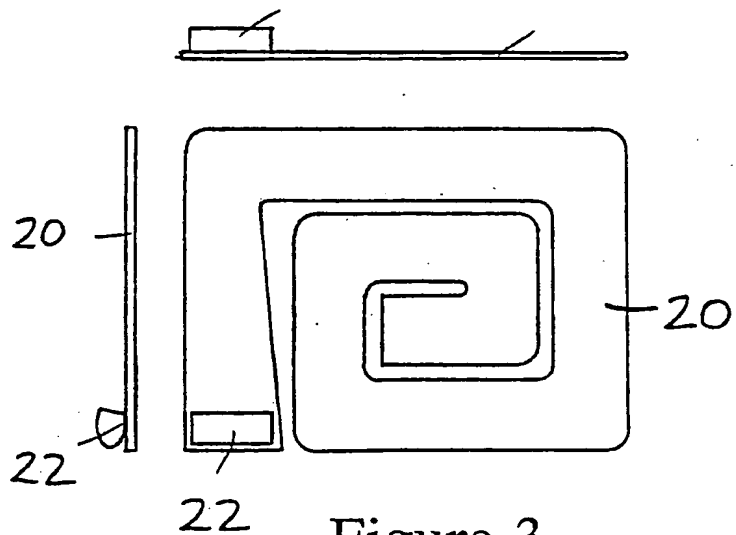
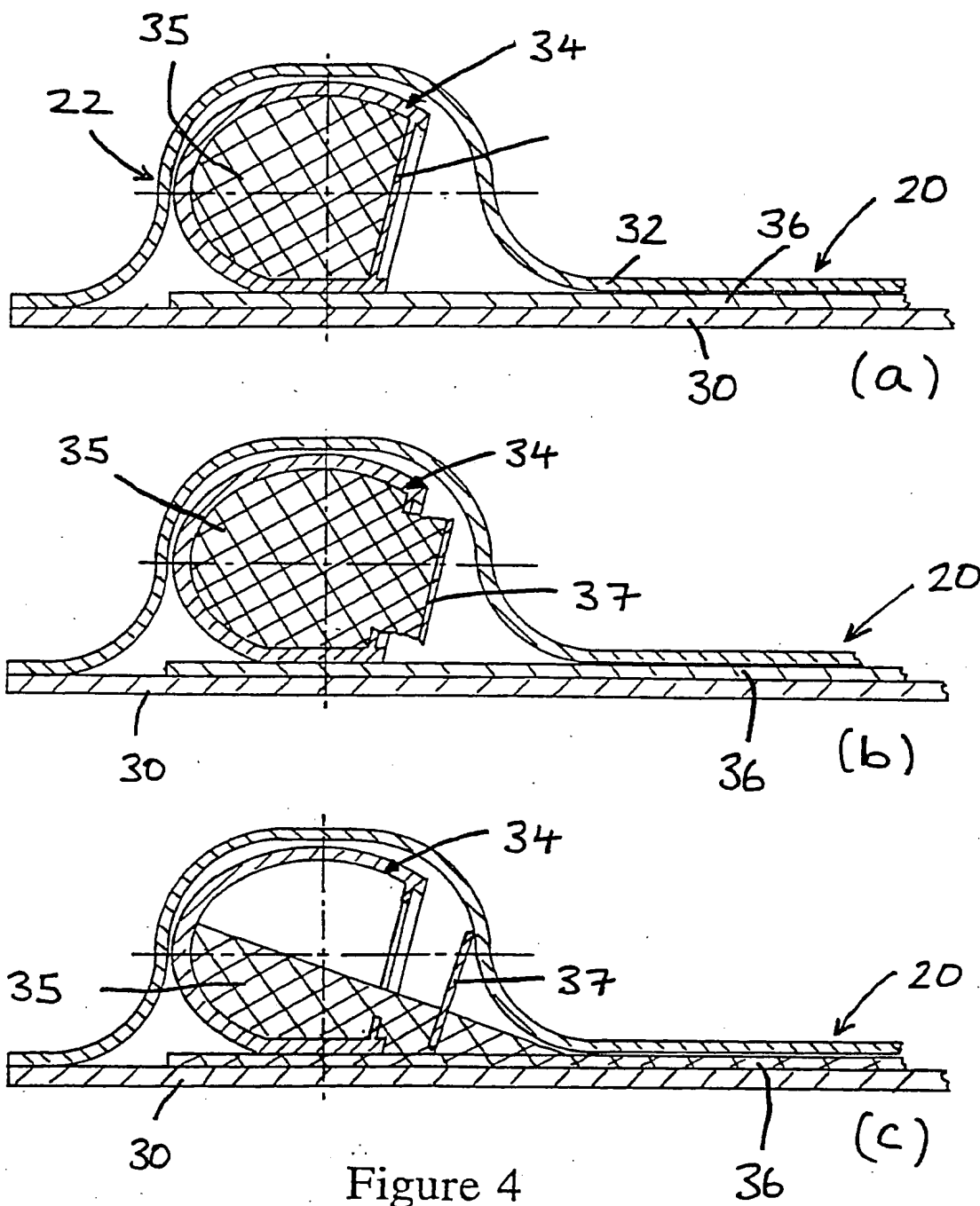


Figure 3

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INTERNATIONAL SEARCH REPORT

Inter. Application No.
PCT/GB 94/02713

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G01K3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 G01K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE,A,16 48 263 (MICHEL J) 6 April 1972 see page 11, paragraph 1 - page 12, paragraph 1 see page 14, paragraph 2 - page 16, paragraph 1 see page 17 - page 19 -----	1-7,10, 11
X	US,A,3 414 415 (BROAD ROBERT L JR) 3 December 1968	1,2
A	see column 2, line 59 - column 4, line 20 -----	9
A	US,A,3 399 284 (MORISON AYERS) 27 August 1968 see column 9, line 41 - column 12, line 11; figures 13-20 -----	8,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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DE-A-1648263	06-04-72	NONE	
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US-A-3399284	27-08-68	GB-A- 1026950 NL-A- 286850	